DW_fp_mult

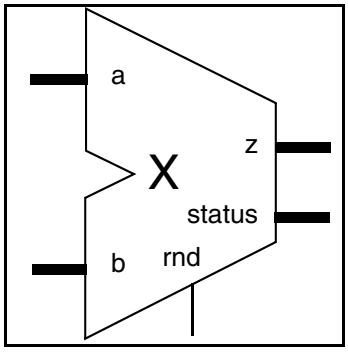
Floating-Point Multiplier

Version, STAR, and myDesignWare Subscriptions: IP Directory

Features and Benefits

Revision History

- The precision format is parameterizable for either IEEE single, double precision, or a user-defined custom format
- Hardware for denormal numbers of IEEE 754 standard is selectively provided.
- Configurable to be fully compliant with the IEEE Std 754-1985 standard
- Configurable for NaN representation compatible with the IEEE Std 754-2008 standard (controlled by the *ieee_compliance* parameter)
- DesignWare datapath generator is employed for better timing and area



Description

DW_fp_mult is a floating-point multiplier that multiplies two floating-point values, `a` and `b`, to produce a floating-point product, `z`.

Component pins are described in Table 1-1 and configuration parameters are described in Table 1-2.

Table 1-1 Pin Description

Pin Name	Width	Direction	Function
a	*exp_width* + *sig_width* + 1 bits	Input	Multiplier
b	*exp_width* + *sig_width* + 1 bits	Input	Multiplicand
rnd	3 bits	Input	Rounding mode; supports all rounding modes described in the *Datapath Floating-Point Overview*
z	*exp_width* + *sig_width* + 1 bits	Output	Product of `a` X `b`
status	8 bits	Output	■ Status flags corresponding to `z`; for details, see STATUS Flags in the *Datapath Floating-Point Overview* ■ status[6]: Underflow before rounding (UBR) status flag When enabled by the *en_ubr_flag* parameter, this flag indicates when the absolute value of a non-zero result, computed as though both the exponent range and the precision of the significand were unbounded, would lie strictly between ±MinNorm (minimum normalized value representable in the FP format defined by *sig_width* and *exp_width*).

Table 1-2 Parameter Description

Parameter	Values	Description
sig_width	2 to 253 bits Default: 23	Word length of fraction field of floating-point numbers `a`, `b`, and `z`
exp_width	3 to 31 bits Default: 8	Word length of biased exponent of floating-point numbers `a`, `b`, and `z`
ieee_compliance	0, 1, or 3 Default: 0	Level of support for the IEEE Std 754 standards: ■ 0: No support for NaNs and denormals; NaNs are considered infinities and denormals are considered zeros ■ 1: Fully compliant with the IEEE Std 754-1985 standard, including support for NaNs and denormals ■ 2: Reserved ■ 3: Fully compliant with the IEEE Std 754-2008 standard[a] For details, see Compatibility with IEEE Std 754 Standards in the *Datapath Floating-Point Overview*
en_ubr_flag	0 or 1 Default: 0	Controls when the underflow before rounding (UBR) flag in `status`[6] is enabled ■ 0: The UBR status flag is disabled (the flag is always 0) ■ 1: The UBR status flag is enabled

a. Propagating payload information to the output during the NaN process, which is an optional feature specified in the IEEE Std 754-2008 standard, is not supported.

Table 1-3 Synthesis Implementations

Implementation Name	Function	License Feature Required
rtl	Synthesis model	DesignWare
str[a]	Synthesis model -- delay optimized for non-ieee_compliance	DesignWare

a. Only available when parameter *ieee_compliance* is 0.

Table 1-4 Simulation Models

Model	Function
DW02.DW_FP_MULT_CFG_SIM	Design unit name for VHDL simulation
dw/dw02/src/DW_fp_mult_sim.vhd	VHDL simulation model source code
dw/sim_ver/DW_fp_mult.v	Verilog simulation model source code

For information about the floating-point system defined for all the DW_fp components, including `status` flag bits, and integer and floating-point formats, refer to the *Datapath Floating-Point Overview*.

Suppressing Warning Messages During Verilog Simulation

The Verilog simulation model includes macros that allow you to suppress warning messages during simulation.

To suppress all warning messages for all DWBB components, define the DW_SUPPRESS_WARN macro in either of the following ways:

- Specify the Verilog preprocessing macro in Verilog code:

  ```
  `define DW_SUPPRESS_WARN
  ```

- Or, include a command line option to the simulator, such as:

  `+define+DW_SUPPRESS_WARN` (which is used for the Synopsys VCS simulator)

The warning messages for this model include the following:

- If an invalid rounding mode has been detected on `rnd`, the following message is displayed:

  ```
  WARNING: <instance_path>:
      at time = <timestamp>: Illegal rounding mode.
  ```

  To suppress this message, use the DW_SUPPRESS_WARN macro explained earlier.

Related Topics

- Datapath Floating-Point Overview
- DesignWare Building Block IP User Guide

HDL Usage Through Component Instantiation - VHDL

```
library IEEE,DWARE;
use IEEE.std_logic_1164.all;
use DWARE.DW_Foundation_comp.all;
-- If using numeric types from std_logic_arith package,
-- comment the preceding line and uncomment the following line:
-- use DWARE.DW_Foundation_comp_arith.all;

entity DW_fp_mult_inst is
  generic (
    inst_sig_width       : POSITIVE := 23;
    inst_exp_width       : POSITIVE := 8;
    inst_ieee_compliance : INTEGER := 0;
    inst_en_ubr_flag     : INTEGER := 0
  );
  port (
    inst_a      : in std_logic_vector(inst_sig_width+inst_exp_width downto 0);
    inst_b      : in std_logic_vector(inst_sig_width+inst_exp_width downto 0);
    inst_rnd    : in std_logic_vector(2 downto 0);
    z_inst      : out std_logic_vector(inst_sig_width+inst_exp_width downto 0);
    status_inst : out std_logic_vector(7 downto 0)
  );
end DW_fp_mult_inst;


architecture inst of DW_fp_mult_inst is

begin

  -- Instance of DW_fp_mult
  U1 : DW_fp_mult
  generic map (
    sig_width => inst_sig_width,
    exp_width => inst_exp_width,
    ieee_compliance => inst_ieee_compliance,
    en_ubr_flag => inst_en_ubr_flag
  )
  port map (
    a => inst_a,
    b => inst_b,
    rnd => inst_rnd,
    z => z_inst,
    status => status_inst
  );

end inst;
```

```
-- pragma translate_off
configuration DW_fp_mult_inst_cfg_inst of DW_fp_mult_inst is
   for inst
   end for;
end DW_fp_mult_inst_cfg_inst;
-- pragma translate_on
```

HDL Usage Through Component Instantiation - Verilog

```
module DW_fp_mult_inst( inst_a, inst_b, inst_rnd, z_inst, status_inst );

parameter sig_width = 23;
parameter exp_width = 8;
parameter ieee_compliance = 1;
parameter en_ubr_flag = 0;


input [sig_width+exp_width : 0] inst_a;
input [sig_width+exp_width : 0] inst_b;
input [2 : 0] inst_rnd;
output [sig_width+exp_width : 0] z_inst;
output [7 : 0] status_inst;

    // Instance of DW_fp_mult
    DW_fp_mult #(sig_width, exp_width, ieee_compliance, en_ubr_flag)
      U1 ( .a(inst_a), .b(inst_b), .rnd(inst_rnd), .z(z_inst), .status(status_inst) );

endmodule
```

Revision History

For notes about this release, see the *DesignWare Building Block IP Release Notes*.

For lists of both known and fixed issues for this component, refer to the STAR report.

For a version of this datasheet with visible change bars, click here.

Date	Release	Updates
June 2022	DWBB_202203.2	■ Added the description of `status`[6] to Table 1-1 on page 1 ■ Added the *en_ubr_flag* parameter to Table 1-2 on page 2 and to the examples on page 4 and page 5
October 2020	DWBB_202009.1	■ For enhanced NaN compatibility with the IEEE Std 754 standards, added a new value for *ieee_compliance* in Table 1-2 on page 2
July 2020	DWBB_201912.5	■ Adjusted the description of the *ieee_compliance* parameter in Table 1-2 on page 2 ■ Added "Suppressing Warning Messages During Verilog Simulation" on page 3 ■ Added this Revision History table and the document links on this page

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